ALGAE

**Didymo (Rock Snot) *Didymosphenia geminata***

Ecology: *D. geminata* is a diatom, which is a type of single-celled algae. Diatoms are extraordinary organisms, unique for their silica ($SiO^2$) cell walls (Spaulding 2007). Diatoms are found in nearly every freshwater and marine aquatic habitat, and supply a large percentage of the global carbon budget through photosynthesis. *D. geminata* is made up of cells that cannot be seen with the naked eye until large colonies form. Only one of these cells needs to be transported for the algae to spread (Biosecurity NZ 2005). In both oceans and freshwaters, diatoms are one of the major groups of organisms within the plankton (including other algae, bacteria and protozoa) and also grow attached to surfaces.

The life history of diatoms includes both vegetative and sexual reproduction (Edlund and Stoermer 1997) *D. geminata* cells possess a raphe, a structure that allows the cells to move on surfaces. The cells also have an apical porefield, through which a mucopolysaccaride stalk is secreted. The stalk may attach to rocks, plants, or any other submerged substrate (Kilroy 2004). It is not the diatom cell itself that is responsible for the negative impacts of *D. geminata*, but the massive production of extracellular stalk. Extracellular polymeric substances that comprise the stalk are largely composed of polysaccarides and protein. They are complex, multi-layered structures that are resistant to degradation (Spaulding 2007). The environmental factors that initiate stalk production are unknown; however, understanding the mechanisms of stalk production is crucial for determining ecological impacts and control of *D. geminata* (Spaulding 2007).

Distribution: Known locations in Utah include: Cottonwood Gulch Creek below Joes Valley Reservoir on the Manti LaSal National Forest (Pers. Comm. Paul Birdsey. 2008. Southeastern Region Aquatic Program Manager, Utah Division of Wildlife Resources), and Rock Creek below Upper Stillwater Reservoir on the south slope of the Ashley National Forest (Pers. Comm. Roger Sneidervin. 2008. Northeastern Region Aquatic Program Manager, Utah Division of Wildlife Resources). Unfortunately, *D. geminata* is broadly distributed in North American (Figure 1) (Spaulding 2007), particularly in the West.

Pathways of Introduction: The mechanisms for *D. geminata*'s expansion into new watersheds are not well understood. Early suggestions that increases in UV-B radiation was tied to the expansion of this species were not supported (Sherbot & Bothwell 1993; Wellnitz et al. 1996; Rader and Belish 1997). Recent work illustrates the capacity of *D. geminata* to survive outside of the stream environment as well as potential vectors in its spread. Cells are able to survive and remain viable in cool, damp, dark conditions for at least 40 days (Kilroy 2005). Fishing equipment, boot tops, neoprene waders, and felt-soles in particular, all provide sites where studies have shown cells remain viable (Kilroy et al. 2006). At the same time, traveling to distant destinations for fishing trips is becoming more common. Rather than returning to a favorite local fishing site, anglers travel to multiple and often distant destinations for fishing vacations.

The arrival of *D. geminata* in New Zealand, in 2004, indicates that it most likely arrived via human-assisted means, such as: on footwear, fishing equipment, boats, etc. (Kilroy

2004).

It is also possible for clumps of *D. geminata* to pass through the guts of birds or other animals, or on the feet or feathers/fur of birds and animals (Atkinson 1980; Kociolek and Spaulding 2000; Kilroy 2004). Wind dispersal of mucilaginous material (the stalks) of *D. geminata* could also occur over short distances (Kilroy 2004).

Management Considerations: *D. geminata* is considered invasive in the United States, since the diatom's blooms cause economic impacts. The human population of the western United States is dependent on a system of canals and pipelines to transport water for hydropower generation, agriculture, and human consumption. Nuisance algae, including *D. geminata*, regularly thrive on the stable substrate and flow regime of canal systems (Pryfogle et al. 1997). In some canal systems, managers implement regular removals by scraping *D. geminata* growths from the concrete surfaces of canals.

*D. geminata* is often reported by recreationalists to land managers as being unattractive. The stalks are often mistaken for raw sewage, leading homeowners and recreationalists to complain to local water treatment plants. Many communities rely on tourism dollars that are generated by outdoor recreation. Natural resource opportunities represent important economic value, yet they may be vulnerable to damage by the spread of this nuisance species.

Studies on the effects of *D. geminata* on native New Zealand fish are in progress. Large amounts of non-nutritious stalk material present on stream substrates are predicted to have harmful effects on native fish. Fish that are dependent on benthic habitat are expected to receive the greatest impact (Larned et al. 2006). If the favored food sources for fish are impacted in a negative way, fish will also be impacted negatively. In New Zealand *D. geminata* has been correlated to increases of invertebrates that are indicators of poor stream health (Larned et. al. 2006).

As with any aquatic invasive species, an aggressive education and outreach program is necessary to change water user's behavior in order to minimize their spread. A public campaign designed to educate anglers, boaters, professional guides, and other recreationalists must be integrated with existing invasive species programs. Freshwater resource users, including water managers, fisheries biologists, and other scientists, need to be aware of the threat and should practice proper decontamination of their equipment to help stop the spread of *D. geminata.*

New Zealand is pursuing a series of experimental trials of biocides for possible control of *D. geminata* within its streams and rivers (Jellyman et al. 2006). Preliminary data from these trials indicate that chelated copper may be effective in controlling *D. geminata.*

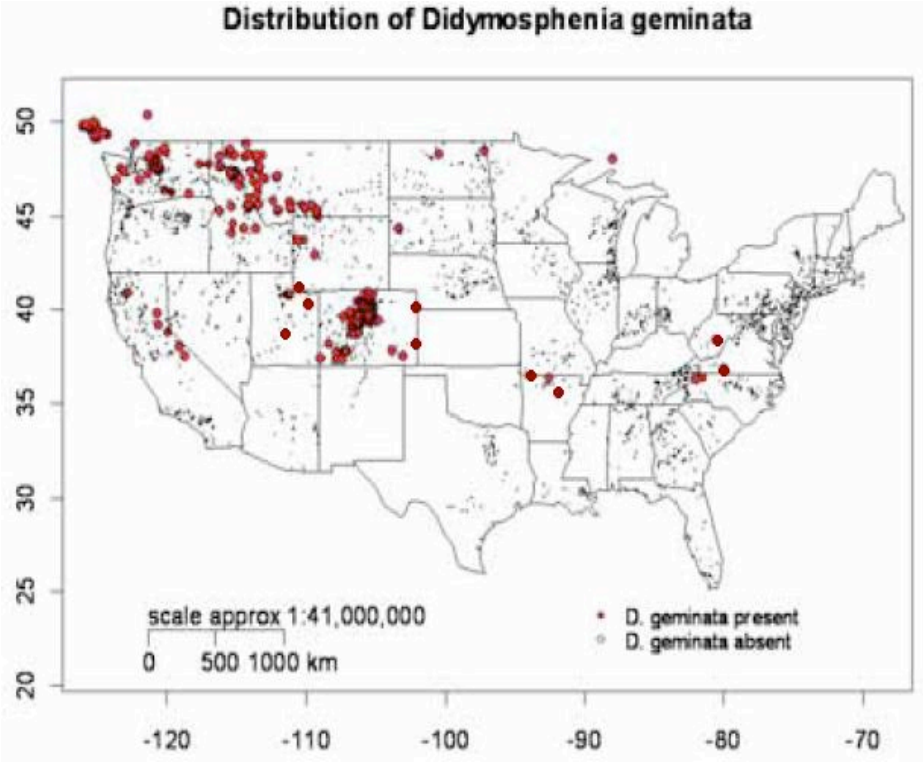


Figure 1.

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Photo by Sarah Spaulding, USGS and EPA

**Didymo covers approximately 50 percent of the substrate in this image from Rock Creek, Utah.**